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ABSTRACT

This study at Miami University (Ohio) compared multiple regression techniques, traditionally used in higher education to examine salary inequities, with compa-ratio analysis. This new technique has been a corporate practice for reviewing salary and gender bias and is now being applied in studies of higher education salary equity. Weaknesses of the multiple regression technique include predictability, large standard deviations, and lack of "human input" in determining variables to be added. In order to compare the two methods at an institution that has used multiple regression for 14 years, multiple regression models were run using the standard process for detecting existing bias with respect to gender and ethnicity, division, and location. Results revealed some differences for white males at the Associate Professor at regional campuses who had lower than expected salaries. Two different compa-ratio methods were also used and they found gender differences at the associate professor level, gender by campus interaction at the assistant professor level, campus differences at the associate professor level, and a gender difference at the professor level. The addition of the compa-ratio raised questions on how faculty salaries can be studied, particularly as they relate to peer institutions. (Contains 10 references.) (JB)

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FACULTY SALARY EQUITY - COMPARISON OF TWO METHODOLOGIES

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This paper was presented at the Thirty-Fourth Annual Forum of the Association for Institutional Research held at The New Orleans Marriott, New Orleans, Louisiana, May 29, 1994 - June 1, 1994. This paper was reviewed by the AIR Forum Publications Committee and was judged to be of high quality and of interest to others concerned with the research of higher education. It has therefore been selected to be included in the ERIC Collection of Forum Papers.

Jean Endo
Editor
Forum Publications

Abstract/Summary

Studies have traditionally utilized multiple regression to examine salary inequities. However, there are weaknesses in the multiple regression techniques, such as the amount of predictability, large standard deviations, and the lack of 'human input' in determining variables to be added. Compa-ratio analysis, a corporate practice for reviewing salary and gender bias, is a new method for use in salary equity studies in higher education. The purpose of this study was to use both methods in determining salary equity issues and use the results to lay the foundation for replacing the standard multiple regression model with the compa-ratio model.

Introduction

Studies have traditionally utilized multiple regression to examine salary inequities (Brittingham, Pezzullo, Ramsay, Long, & Ageloff, 1979; Long, 1979; Morse, 1979; Muffo, Braskamp, & Langston, 1979; Schau & Heyward, 1987) , a methodological approach proposed by Scott (1977) in a widely cited study. However, there are weaknesses in the multiple regression techniques, such as the amount of predictability (sometimes less than 50 percent), large standard deviations, and the lack of 'human input' when determining which variables should be added, as occurs in the stepwise approach (Moore, 1993). In 1991, Bereman and Scott introduced compa-ratio analysis, a tested corporate practice for reviewing salary and biases, to higher education and salary equity studies. The purpose of this study was to use the standard regression analysis that has been conducted at a doctoral institution over the past fourteen years and then to introduce this new statistical approach to the administration with the intent that the results from the compa-ratio would verify the regression results and perhaps over the next few years, replace it as the procedure for identification of salary inequities.

Regression Analysis: Methodology

The traditional stepwise regression analysis was used to identify the attributes related to professional experience and qualifications that are correlated with the university faculty's current salaries. Although this procedure has drawbacks, it has been used locally

for a number of years and, therefore, to maintain consistency it was again used this year.

Data were gathered on 860 1992-93 full-time university faculty, using the same criteria for inclusion as in the AAUP and IPEDS salary surveys. In order to optimize group sizes, lecturers and senior instructors were grouped with assistant professors, assistant instructors were grouped with instructors and the faculty at the two branch campuses were grouped together as regional campus faculty. The following data elements were used in the regression equations for predicting 1992-93 faculty salaries: academic rank, years of university service, age, years in current rank at the university, years since completion of highest degree, possession of doctorate (dummy variable with 0 = no doctorate, 1 = doctorate or other higher degree) and relative market value of the individual's discipline. This disciplinary market factor is from the National Association of State Universities and Land-Grant Colleges (NASULGC) 1991-92 Faculty Salary Survey by Discipline conducted by the Office of Institutional Research at Oklahoma State University. It is a measure of current relative disciplinary market value defined as the national ratio of (the average salary paid to faculty at a given rank in a specific discipline) to (the average salary paid to faculty at that rank in all disciplines combined). This is used in place of department, which is included in many salary equity studies, to identify differences in market value or worth.

Two models were used within stepwise regression to determine salary equity at each individual rank (excluding rank from the regression model) and secondly by using the four ranks as dummy variables. They were: all white main campus males, and all faculty. From these analyses, the residuals (actual minus predicted salary) were tested for

significant differences on gender and campus (main versus regional) using analysis of variance (ANOVA). Similar procedures were used to test for ethnic salary bias, and for divisional differences.

Analysis and Results: Gender Equity

The first series of analyses - using both models - looked at each rank independently. The model using white main campus male faculty as the basis for building an equation for predicting salary was run first to determine the existence of gender inequities in salaries at each rank. This is the standard process for detecting existing bias. After the equations were established with the predictor variables (Table 1), a 2-way ANOVA was run on the residual salaries (Actual salary minus Predicted salary) to test for statistically significant differences for gender and campus (main vs regional).

At each of the four ranks, there were no statistically significant differences 1) between males and females with respect to their residual salaries, 2) between the main campus and the regional campus and 3) interactions between gender and campus.

Table 1

Stepwise Regressions Equations for Salary Prediction: White Main Campus Male Model

Predictor Variables	Professor		Associate		Assistant		Instructor	
	b	R^2	b	R^2	b	R^2	b	R^2
Age	--------		188.13	0.66	--------		--------	
Yrs of Service	-874.95	0.46	--------		563.65	0.82	--------	
Yrs in Rank	994.72	0.25	358.34	0.64	--------		693.55	0.57
Yrs since Dgr	693.49	0.63	--------		-188.55	0.83	--------	
Possess Doct	---------		--------		--------		--------	
Market Factor	327.35	0.56	345.99	0.44	333.75	0.73	--------	
Constant	20989.25		867.01		2930.06		26771.12	
Overall R^2		0.63		0.66		0.83		0.57

The second model,using all faculty as opposed to white main campus males, is based on the assumption that there is no bias in salary (see above) and is typically the primary model used when the purpose of a study is to explain or predict salary levels. After the stepwise regression analysis was run, equations were established for each rank (Table 2).

When a 2-way ANOVA (gender by campus) was run, no statistically significant differences were found. Tables were supplied to the Provost that included information for each individual faculty with respect to their salary, residual from predicted salary and those who fell 1.0 to 2.5 standard deviations above or below the mean residual of their respective rank.

Table 2

Stepwise Regressions Equations for Salary Prediction: All Faculty Model

Predictor Variables	Professor		Associate		Assistant		Instructor	
	b	R^2	b	R^2	b	R^2	b	R^2
Age	--------		--------		--------		--------	
Yrs of Service	-819.33	0.46	174.87	0.63	458.45	0.75	--------	
Yrs in Rank	1045.89	0.27	344.89	0.61	--------		658.52	0.22
Yrs since Dgr	600.23	0.63	--------		--------		--------	
Possess Doct	---------		--------		--------		--------	
Market Factor	327.16	0.57	328.04	0.41	324.96	0.55	125.45	0.32
Constant	21560.48		8991.61		3190.63		13957.09	
Overall R^2		0.63		0.63		0.75		0.32

The second series of analyses - run on both models - used each rank as a dummy variable (e.g., Professor: 1 = Yes 0 = No). As before, the white main campus male model was run first to identify any bias in salaries. After the residuals were calculated using the equation of statistically significant predictors (Table 3), a 2-way ANOVA was run (gender by campus) for each rank.

The only statistically significant difference found on the residuals was a gender by campus interactive effect at the Associate Professor level. The mean residuals show that the male Associate Professors at the regional campuses have much lower actual salaries with respect to their predicted salaries than do any of the other three groups (-2,912 vs 60, -630 and 1,077). This large difference, coupled with the female Associate Professors at the regional campuses having the largest positive mean residual(1,077), explains the statistically

significant interaction effect.

Table 3

Stepwise Regression Equations for Salary Prediction: Using Rank as a Dummy Variable

Predictor Variables	White Male Main Cmp Fac		All Faculty	
	b	R^2	b	R^2
Academic Status:				
Professor	22211.61	0.47	21525.40	0.49
Associate	8169.09	0.78	7415.99	0.61
Assistant	--------		--------	
Instructor	-9284.57	0.80	-9561.66	0.82
Age	172.48	0.83	131.65	0.84
Years of Service	-520.26	0.82	-385.67	0.83
Years in Rank	850.22	0.72	782.42	0.79
Years since Highest Dgr	171.17	0.83	128.64	0.84
Possess Doctorate	--------		--------	
Disciplinary Market Factor	324.85	0.59	314.02	0.70
Constant	-3692.03		-854.25	
Overall R^2		0.83		0.84

In the all-faculty model using rank as a dummy variable, an equation almost identical to the white main campus male model was developed. In the 2-way ANOVA of the residuals, a statistically significant difference for Associate Professors was again found in the gender by campus interaction. The mean residuals show the same pattern as in the previous model, with male Associate Professors on the regional campuses having a markedly larger negative mean residual, and the regional campuses female Associate

Professors with a large positive mean residual.

Analysis and Results: Ethnic Equity

The same procedures were used to test for ethnic salary inequities as were used for testing for gender bias in salaries. Because of the small number of full-time faculty in the various ethnic groups, all minority faculty were grouped together for the initial regression analyses. Then, if any statistically significant differences were found, separate analyses would be run on those means to identify which groups were actually contributing to the differences.

The first model was developed using all white faculty and was run for each of the four ranks (Table 4). When ANOVAs were run on the residuals comparing white faculty to minority faculty, the only statistically significant difference was found at the Assistant Professor level. Here minority faculty had a mean residual of over $1,400 higher than white faculty.

In the second model, using the all faculty model, an ANOVA was run on the residuals comparing minority to white faculty and as expected (since there was a significance in the previous model), there was a statistically significant difference at the Assistant Professor level (white = -209; minority = 1,147). Because of this significant difference, T-tests were than run for each ethnic group against the remaining faculty to identify where the differences at the Assistant Professor level were actually occurring. The results of these T-tests show that the difference is occurring in the black assistant professor

salaries, that is, black Assistant Professors have statistically significant higher positive residuals (actual minus predicted) than the remaining Miami Assistant Professors. A further breakdown shows that this difference can be tied to the black female Assistant Professors.

Table 4

Stepwise Regressions Equations for Salary Prediction: White Faculty Model

Predictor Variables	Professor		Associate		Assistant		Instructor	
	b	R^2	b	R^2	b	R^2	b	R^2
Age	--------		--------		--------		--------	
Yrs of Service	-803.12	0.46	181.77	0.61	482.31	0.78	--------	
Yrs in Rank	957.14	0.27	319.17	0.60	--------		668.40	0.24
Yrs since Dgr	697.14	0.63	--------		--------		--------	
Possess Doct	---------		--------		--------		--------	
Market Factor	336.04	0.57	322.55	0.41	328.75	0.56	135.64	0.34
Constant	19005.15		9567.46		2457.04		12858.03	
Overall R^2		0.63		0.61		0.78		0.34

Analysis & Results: Divisional Equity

Using the equations defined by the "all faculty" model, residuals were analyzed for divisional differences using ANOVA. Statistically significant differences were found between divisions at all four ranks (Table 5). In order to determine which divisions were contributing to these differences, T-tests were run for each of the ranks, comparing each division's mean residuals for faculty at these ranks to the remaining university

faculty at the same rank. The tests found that for Professors, the statistically significant divisional difference can be attributed to School 'B' where Professors in this school have mean residual almost $3,700 greater than the remaining university Professors and to School 'D' whose Professors have a mean residual of nearly $2,600 less than the remaining university professors.

Table 5

ANOVA of Divisional Differences on Mean Residual by Rank

Rank	F-Statistic	p-value
Professor	3.134	.009
Associate Prof	3.911	.002
Assistant Prof	2.458	.034
Instructor	3.997	.003

At the Associate Professor level, the statistically significant difference is found to lie in two divisions - School 'F' where the mean residual for Associate Professors is over $3,600 greater than the mean for all other Associate Professors and in School 'A' with a lower mean residual (difference of $1,000) than the remainder of the faculty at this rank. For Assistant Professors, the difference was found in School 'A' with a lower mean residual from the rest of the faculty and statistically significant T-value.

II. Compa-Ratio Analysis: Methodology

In a recent study, Bereman and Scott (1991) introduced compa-ratio analysis, a tested corporate practice for reviewing salary and identifying potential bias between groups of employees, to higher education. The compa-ratio is the "ratio of an actual pay rate (numerator) to the midpoint for the respective pay grade (denominator)" (Bereman and Scott, 1991). For example, a compa-ratio for an individual of less than 1.0 says that he/she is being paid below the average for a particular pay grade and a compa-ratio for an individual that is greater than 1.0 indicates that he/she receives compensation above the pay grade average.

According to Bereman and Scott, the compa-ratio has been used in industry for cost control, merit pay decisions, to track changes in salaries due to turnover, revised hiring policies, corporate goal changes, etc. and to determine departmental compliance with corporate policy. Finally, it has been "applied to the problems of differential salary treatment of selected groups of employees in conjunction with multiple regression techniques. After separating employees by such demographics as gender, race or age group, a compa-ratio analysis could provide a first indication that there is potential bias for or against certain groups of employees" (Bereman & Scott, 1991).

In their analysis, applying this theory to higher education, Bereman and Scott developed a compa-ratio based on faculty rank and discipline. This was achieved by dividing each faculty member's salary by the NASULGC salary average for his/her rank and discipline. This ratio was then used to identify faculty who were above or below the

national average. Their findings indicated that the compa-ratio is flexible enough to move into the higher education community with a simplicity that allows for basic understanding within that community. "It permitted the institution to examine all salaries in the context of the national academic labor market, thereby mitigating internal discriminatory influences while assessing relative competitiveness across disciplines" (Bereman & Scott, 1991). The key to the acceptance of compa-ratio in salary equity analyses rests on the acceptance of rank and discipline as appropriate predictors of salary, in combination with other measures such as time in rank.

In summary, the authors pointed to possible applications of the compa-ratio technique:

1. By using mean salaries at each rank within an institution, the internal salary structure could be evaluated. This would enable administrators to:
   - identify problems in the university salary structure, such as compression and inversion.
   - identify the responsiveness over time to university goals through salary adjustments.
   - compare salary levels across departments and common disciplines.
   - estimate the cost of implementation of salary adjustments when parity between particular groups needs to be addressed.

2. Using external salary data such as NASULGC or CUPA, the compa-ratio could compare a university's salary scale to either a national or regional academic labor

market. This would allow the university to:

- measure competitiveness of current salaries in discipline areas where there is a shortage of faculty and to also identify the salaries needed to draw new assistant professors to the campus.
- measure the cost of enhanced competitiveness.

3. In the context of salary biases, the compa-ratio could serve as a monitoring device, a means by which institutional progress toward salary equity would be checked and understood.

Two different methodologies were utilized using the compa-ratio concept to evaluate salaries at the university. First, simple comparisons were made between male/female, main/regional campus, minority/non-minority and divisional compa-ratios at each rank. Second, new regression analyses were conducted eliminating the disciplinary market factor and rank as components of the equation and replacing faculty salary with individual compa-ratios to determine the existence of gender biases.

Compa-Ratio Analysis: Method 1

Using the individual faculty compa-ratio, subgroup means were calculated by averaging individual ratios rather than dividing the total salaries by total NASULGC rank/discipline averages. Table 6 shows the means by various subgroups that identify how the university's faculty salaries compare to the national average for particular ranks and

other subgroups - gender, campus, ethnicity and division.

Table 6

Mean Compa-Ratios by Rank and Selected Subgroups

Group	All Ranks		Professor		Associate		Assistant		Instructor	
	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N
Total Univ	1.03	860	1.01	265	1.05	277	1.03	247	1.03	71
Male	1.03	597	1.01	238	1.06	197	1.03	126	1.06	36
Female	1.02	263	1.00	27	1.02	80	1.03	121	1.01	35
Main	1.03	756	1.01	255	1.05	242	1.02	198	1.04	61
Regional	1.02	104	0.97	10	1.00	35	1.05	49	1.00	10
School 'A'	1.03	456	1.01	156	1.07	140	1.02	131	1.00	29
School 'B'	1.11	115	1.10	32	1.07	33	1.09	36	1.25	14
School 'C'	0.96	145	0.95	38	0.97	49	0.99	37	0.87	21
School 'D'	1.03	76	1.00	25	1.05	27	1.03	22	1.17	2
School 'E'	1.01	55	0.97	11	1.04	23	0.96	17	1.19	4
School 'F'	1.11	13	0.93	3	1.13	5	1.14	4	1.46	1
Minority	1.03	72	1.03	11	1.03	17	1.03	38	1.00	6
Non-Minority	1.03	788	1.01	254	1.05	260	1.02	209	1.04	65

Looking at the compa-ratio by gender, it is apparent that overall both males and females at all ranks have salaries that are comparable to or even above the average of the national

salaries (taking into account discipline). When tested for difference between the means there is a statistically significant difference at the associate professor level, with the male compa-ratio higher than the female compa-ratio.

There was a statistically significant campus difference at the associate professor level, but there were no statistically significant minority/non-minority differences at any rank. Finally, when a 2-way ANOVA was run on the compa-ratio of gender by campus, only gender differences were statistically significant (at the Associate Professor level)- campus differences became statistically insignificant. That is, when both gender and campus location are considered together, gender alone accounts for any statistically significant differences in the compa-ratio at the Associate Professor level.

Compa-Ratio Analysis: Method 2

In this method, the compa-ratio is substituted for salary in the regression analyses and disciplinary market factor and rank are removed as predictors. After a regression equation was developed, ANOVAs were run on the residuals to look for significant differences at each rank with respect to gender and campus and on the faculty as a whole. The regression results are shown in Table 7. The first regression was run on white main campus male faculty to determine the presence of gender inequities at each rank and to parallel the standard regression models. The variables included in the stepwise regression were age, years of service at the university, years in current rank, years since highest degree received and the possession of a doctorate.

Table 7

Stepwise Regression Equations for Compa-Ratio Prediction

Predictor Variables	White Male Main Cmp Fac		All Faculty	
	b	R^2	b	R^2
Age	0.003	0.35	--------	
Years of Service	-0.008	0.33	-0.006	0.29
Years in Rank	0.017	0.28	0.017	0.26
Years since Highest Dgr	--------		0.002	0.30
Possess Doctorate	-0.053	0.34	-0.029	0.30
Constant	0.882		0.973	
Overall R^2		0.35		0.30

When 2-way ANOVAs were run at each rank on the compa-ratio residuals created from the white main campus male regression model, significant F-statistics were found for Professors by gender, for Associate Professors by campus level and for Assistant professors in the gender by campus interaction. For both male and female Professors, their mean compa-ratio residuals were negative (actual smaller than predicted), however, male Professors displayed a larger negative value (-.026) implying that they have a smaller actual compa-ratio as compared to their predicted than do their female counterparts (-.021). That is, female Professors have a mean compa-ratio closer to predicted than do male professors.

At the Associate Professor level, the statistically significant difference is caused by the regional campus Associate Professors having a mean residual of -.023 compared to the

main campus faculty where their mean residual was .029. That is, the compa-ratio predicted for Associate Professors at the regional campuses was higher than their actual compa-ratios and the resulting mean residuals were markedly different from their main campus counterparts.

At the Assistant Professor level the mean residuals of the interaction of gender and campus show that regional campus female faculty have the lowest mean residual while the regional campus male faculty have the highest mean residual. That is, female Assistant Professors on the regional campuses have compa-ratios below the compa-ratio as predicted by the regression equation, and regional campus male Assistant Professors have compa-ratios above their predicted ratios.

Using the all-faculty model, residuals were calculated from the regression equation (Table 5) and 2-way ANOVAs were then run on these residuals using gender and campus. The results from the ANOVA's were of the same type as those found in the white main campus model, a gender difference for Professors, a campus difference at the Associate Professor rank and a significant gender by campus interaction at the Assistant Professor level.

Conclusion

The traditional salary equity analyses conducted this year continue to reinforce the knowledge that the university does not adversely discriminate on the basis of gender or ethnicity with respect to faculty salary. However, when looking at the regression model with rank as a dummy variable, a gender by campus interaction effect was found at the

Associate Professor level.

When using compa-ratio as the basis for determining salary equity, simple tests of the mean showed a gender difference at the Associate Professor level. When using a regression model, replacing salary with compa-ratio, additional differences were found - gender by campus interaction at the Assistant Professor level, a campus difference at the Associate Professor level and a gender difference at the Professor level. However, these differences do not necessarily reflect an inequity in the direction most often assumed in faculty salaries. In fact, the opposite is true. That is, the average male faculty compa-ratio is lower than the female (or in the case of regression analyses, the mean residual) at both the Associate Professor and Professor levels. The campus difference at the Associate Professor level in the regression analyses is reflective of the results from the standard regression models. Finally, at the Assistant Professor level, the interaction of campus and gender can be explained by the combining of Senior Instructor (found largely on the regional campuses) with Assistant Professor and the phenomena found at this university - tenured Assistant Professors (once again, more readily found on the regional campuses).

These studies supply us with the ability to identify those faculty, male and female, whose actual salaries fall significantly above and below what is predicted for them given criteria such as years of service, years in current rank and the discipline in which they teach. With this information, the administration can continue to address inequities concentrating on those areas where statistically significant differences have been identified.

Implications for Future Research

The addition of the compa-ratio to this study has raised questions on how faculty salaries can be studied, particularly as they relate to peer institutions, and also how this particular analysis can be applied to non-faculty salary equity studies. Suggestions for future study include: creation of an internal (university-wide) disciplinary market factor component that would replace the national figures used in the above study, use of a peer-group summary from the Oklahoma salary study rather than the national summary of the disciplinary market factors, and use of other salary data sources such as CUPA or other peer group comparison surveys that the university has participated in. Finally, it would be prudent to expand this compa-ratio philosophy to the non-faculty population of the university in order to identify possible salary inequities within classes of employees.

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